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ADDRESSES AT THE OPENING ASSEMBLY OF THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS[1]

THE following addresses were delivered at the official opening of the Seventh Triennial Assembly of the International Union of Geodesy and Geophysics in the Departmental Auditorium, Washington, D. C., on Wednesday evening, September 6, at 8:30.

In opening the assembly, Dr. Richard M. Field, president of the American Geophysical Union, stated that: "Through the courtesy of the Government of the United States of America, the American Geophysical Union, with the cooperation of its parent body, the National Research Council, has both the privilege and the honor of acting as host to one of the most significant international organizations in the promotion of science among the nations of the earth—the International Union of Geodesy and Geophysics. In differentiating the work of this international body from that of national scientific societies, it is the peculiar province of this Union to devote itself to furthering the knowledge of the sciences of the earth in those particular fields where international cooperation is most necessary.

"The program of this seventh assembly now gathered in Washington includes those fundamental aspects of the sciences which deal with the problems of the earth's crust, its oceans and its atmosphere; problems that can not be solved without the cooperation of the many nations to whom are entrusted the various territories of our globe.

"We recognize that this assembly is called at a time of unusual stress, and the Executive Committee of this Union is therefore especially conscious of its

[1] September 6, 1939, Washington, D. C.

responsibilities since both our foreign colleagues and the Department of State have expressed the hope that we may continue our meetings essentially as scheduled in spite of disturbed conditions abroad. I am sure that I express the unanimous feelings of our American Geophysical Union, as an adhering unit of the International Union, when I state that the pursuit of science recognizes and includes those individuals of all races and nationalities whose devotion to extending the frontiers of knowledge make for international good-will and for the enlightenment of mankind.

"May I now introduce the Honorable Hugh R. Wilson, who will read an address of welcome by the Secretary of State, the Honorable Cordell Hull."

Mr. Hull's address was as follows: "I am pleased to have this opportunity to greet and welcome on behalf of the Government and people of the United States the distinguished delegates to the Seventh General Assembly of the International Union of Geodesy and Geophysics. It is regretted that recent events in Europe have prevented the attendance of many of your colleagues, and we all sincerely deplore the circumstances which have made their absence necessary. We deeply appreciate your selection of Washington as the seat of this important conference and we are honored by your presence. I offer to you our warmest hospitality.

"You have assembled not only as official representatives of your respective governments but also as the representatives of one of the most eminent of scientific bodies. The fruits of your tireless efforts are everywhere evident and universally enjoyed. All humanity benefits directly from your findings.

"The discussions at past general assemblies have contributed immeasurably to the store of knowledge of the earth's sciences. Delegates have brought to these international meetings important scientific facts growing out of their researches and experiences and in a spirit of true unselfishness have imparted this knowledge to their colleagues in all parts of the world. This free exchange of scientific information is a practical demonstration of the interdependence of science and a recognition of the benefits accruing to the entire world through the wide dissemination of significant professional truths.

"The work of a number of our governmental bureaus and private institutions is influenced directly by the discoveries and decisions made by members of your international organization. This Government constantly avails itself of the valuable publications of the International Union of Geodesy and Geophysics which could be duplicated by any one government or private organization only with great cost and difficulty. Your studies in the fields of geodesy, seismology, volcanology, meteorology, terrestrial magnetism and electricity, oceanography and hydrology are of daily interest and importance not only to our governmental agencies responsible for official activities in those spheres but also to innumerable private organizations and individuals whose economic existence is dependent upon your efforts. Millions of persons throughout the world owe in a large measure their comfort and livelihood to your notable contributions to the improvement of scientific aids to transportation by water, land and air, of building methods designed to minimize danger from earthquakes, of agricultural practices utilizing knowledge of surface and subterranean water supplies, of geophysical methods of prospecting and of the study of underground formations. It is the good fortune of the Government and people of the United States to have the opportunity of serving as hosts to those distinguished scientists who have labored diligently and unostentatiously in these fields so that the lot of their fellow men may be improved.

"This evening you meet as friends and colleagues to inaugurate the seventh in this series of scientific discussions. Through modern international cooperation science has progressed with strides which would have been impossible if restricted within national and economic borders. This cooperation is made possible through international gatherings such as we are opening this evening. Individually and collectively, your work is facilitated through the knowledge that your fellow scientists throughout the world are friends whose unselfish efforts are directed toward the creation and clarification of knowledge that can be utilized in every-day life to the advantage of all. The prevailing spirit in this assembly is one of friendliness, good-will and mutual understanding and respect. It is my fervent hope, which the people of this country share, that the day may soon come when the statesmen of the world will take a leaf from the book of the scientists and solve international political problems in the same dignified and friendly spirit."

Professor S. Chapman, chairman of the British National Committee, replied as follows: "As representing the nation which last received this Union, at its Edinburgh Assembly, I have been privileged by the American Organizing Committee and by the United States Government with the invitation to respond, in the name of the International Union of Geodesy and Geophysics, to the address of welcome, on behalf of the Government of the United States of America, with which we have been favored by the Honorable Secretary of State, Mr. Cordell Hull.

"During its twenty years of life now past, the Union has hitherto always met in one or other of the historic national capitals of Europe—in Rome, in Madrid, in Prague, in Stockholm, in Lisbon and in Edinburgh. At these assemblies an important share

in the activities and the success of our meetings was taken by the large and influential American delegations which came to meet with us in Europe. On the occasion of this assembly the direction of travel has been to and not from these shores. Across the Atlantic and Pacific oceans we have come to meet together with a still greater number of our American colleagues in this no less historic capital of Washington.

"We are indeed glad to be present in this home of the greatest of all national societies for the study of geophysics, the American Geophysical Union—a society which has grown and flourished under the long-fostering care of its secretary, Dr. Fleming.

"The hospitable good-will shown by the United States Government toward our Union, in making the necessary provision for these arrangements, is further testified by the cordial address of welcome which we have to-night heard from Mr. Wilson on behalf of the Honorable Secretary of State. For this welcome I wish in the name of the Union to express our hearty thanks, and I would also affirm our confident hope that, despite the shadow of war which has fallen upon us while we have been gathering together here, this Washington meeting will prove to be one of the most harmonious and successful of our assemblies."

Dr. Cloyd Heck Marvin, president of George Washington University, then welcomed the International Union in the name of the local institutions as follows: "On behalf of the City of Washington, and on behalf of the George Washington University, I greet you. The Commissioners of the District of Columbia bid me transmit to you their personal welcome to the Nation's Capital. We of the University count it an honor and a privilege to have you assemble within our halls.

"Probably never before in its history has the Union met under conditions so difficult as those that confront it to-day—deprived of the collaboration of some of its member nations; its delegates harassed by thoughts of what is transpiring beyond the seas.

"Yet these very circumstances serve to emphasize the transcendent importance of what you are doing and what you represent. The Union has, indeed, become a symbol, standing for those enduring values, those fundamental phases of human activity that will continue even during the present crisis, and that will resume in full force when the stress of these days shall have passed. It is inspiring to know that those delegates who were called back to their countries have so earnestly desired and requested that the Assembly be not interrupted, and that you who remain—many of you in the face of deep personal anxieties—are going forward so splendidly.

"The earth sciences—there is something in the very phrase suggestive of eternal verity. If the disinterestedness, the selflessness, of the scientific discipline could be carried over into the management of human affairs, then might the peoples of the earth be enabled to live together in accord, directing their energies not toward destruction, but toward human betterment.

It is for this reason that at this hour we are peculiarly glad to have you in our midst, because for us you connote Science—Science that knows no national boundaries, no ideological frontiers, but that calls to all men of intelligence, everywhere."

Dr. Frank B. Jewett, president of the National Academy of Sciences, spoke as follows: "I feel it an honor to have been asked to participate in this official welcome to you who come as representatives of many countries of the world to form the Seventh General Assembly of the International Union of Geodesy and Geophysics. This is your first general meeting in the United States, and, speaking for American science, I trust that it will prove both pleasant and profitable. I know that we shall enjoy having you in our midst.

"It is a difficult thing to phrase a welcome to an international gathering at this time when the world of yesterday and to-day is being plunged headlong into the unknown world of to-morrow. All we can know is that the horror, devastation and destruction of a world war is beyond human imagining. How it will affect us individually or as nations no one can know—probably it is well that we can not.

"Nor can we sense in what way it will affect science—particularly fundamental science. We do know from the experience of twenty years ago that certain sectors of applied science were tremendously stimulated and that the drain of research men into some phase or other of the maelstrom retarded temporarily certain advances. Whether the retardation was not more than overcome during the 1920's and since none can say, however.

"Because of all that war on a world scale portends; because I am low in my mind at the thought that man after untold thousands of years has not yet evolved any better way of settling his mass difficulties than by mass murder; and because I do not even know how many of our foreign friends have been prevented from coming, my remarks are not at all those I had originally planned to give. If they seem quite inadequate I trust you will be charitable and remember that they are given against the background of an experience I dread having to face again.

"You are here as the guests of the American Geophysical Union acting with the cooperation of the National Research Council. It is therefore my pleasant duty to-day to represent what in reality is the parent of your host. As most of you doubtless know, the National Research Council, technically a committee of the National Academy of Sciences, is in reality a sort of business organization subsidiary to it. I need

scarcely explain to you how such an arrangement is at times a very convenient one. For instance, it permits the parent to do certain things of which he imagines the child will remain ignorant; but actually, as in family life, the child is seldom so unobservant. It also permits the child to indulge in many liberties, ostensibly without the parent's being aware of what is going on. Let me assure you, however, that when the academy's offspring, the National Research Council, joined in inviting the Seventh General Assembly to convene in Washington, it was not one of those childish tricks of waywardness which the parent found it convenient to overlook. On the contrary, I am here to-day as president of the National Academy and I assure you that both the academy and American science as well feel honored by your visit.

"It seems inevitable and also fortunate that as the bounds of our knowledge expand, there should be increasing occasion for international cooperation in scientific endeavor. Just as mathematics and music are already international languages, the work of organizing to advance science is based upon a community of interest which can scarcely be expected to bear much relation to such accidentally conceived things as geographical boundaries. From the standpoint of science, lines of political separation can scarcely measure up in significance to the lines of demarcation which we arbitrarily and solely for the sake of convenience create when we speak, for instance, of physics, chemistry and biology as different departments of science. We know from the present-day activities which we label by such hyphenated terms as bio-chemistry and chemical-physics how fruitful the eradication of boundaries can be. Further, as one looks around at the present scene in world politics, he is tempted to venture a guess that if there were some way short of mass killing to eradicate the other kind of boundary we might all also stand to gain by the process.

"But history discloses many periods during which one or another department of science has lain fallow or quiescent. And perhaps the least that we can expect is that, from time to time, there will arise such sets of circumstances as to throw the international aspects of science into the background. In many respects we have been passing through such a period for the past half dozen years, and now that national issues have been joined in war, it will be accentuated. No one can say that it is an irretrievable loss however. After all, there is much sound philosophy in that line from Shakespeare which now amounts almost to a proverb, that by indirections we find directions out. I need not recall to your minds that science itself, although actuated only by the most enlightened of motives and guided solely by the most rigorous of logic, has on many occasions had to resort to indirections, finding the correct course finally by the method of trial and error.

"While your cooperative efforts and your sessions may be somewhat handicapped by the lack of political understanding which now manifests itself between nations, you are, relatively speaking, fortunate in another regard. So far as I can see, you are unembarrassed in your deliberations by the hoard of economic and sociological quandaries which at the moment beset the applied scientist either when he looks backward to contemplate his past achievements or forward in an attempt to plan the constructive contributions to the future.

"From the dawn of the human race man has existed in an environment which, if it changed at all, changed by only imperceptible amounts. But science has upset this provision of nature, and a creature which through the centuries was called upon to adapt itself only to slow changes finds itself in a veritable maelstrom. It helps not that the maelstrom is largely of his own making, no more than it helped Pandora to know that she herself had opened the troublesome box.

"As you have doubtless noticed, whenever applied scientists and engineers congregate these days, their discussions sooner or later veer over into the sociological and economic fields. I foresee no such anticlimax for your present deliberations. By refining the measurement of an arc of the earth's circumference or by adding another significant figure to the acceleration of gravity or another region of ionization to the upper atmosphere, your conscience need not—at least for the moment—trouble you with any thought that you are enspiriting that famous bugaboo known as technological unemployment. Your researches appear to be at least one stage removed from such sociological considerations. I therefore envy the air of detachment which, for the next few days at any rate, you are at liberty to indulge in.

"Whatever the future has in store for the world and its inhabitants, it is, I think, safe to say that every increment to our store of real knowledge is potentially an increment added to a better way of life. It may be a long way off, but the possibility of its attainment justifies our continuing the quest. The field you represent is one of the most important in the whole domain because it is concerned with the very foundation on which all else rests.

"On behalf therefore not only of the National Academy of Sciences and of the National Research Council but of American science in its entirety I wish you an outstandingly successful conference."

Dr. D. La Cour, of Denmark, then delivered his presidential address.

ADDRESS OF DR. D. LA COUR

IN the name of the International Union of Geodesy and Geophysics I have the privilege to express the sincere thanks of the Union to the speakers who have so kindly welcomed the Union at this meeting. We are greatly honored by what you have said and enjoy the feeling of having your sympathy, and we are grateful for your contribution to the festival opening of our Assembly.

It proceeds from my heart when I express the very sincere thanks of the International Union of Geodesy and Geophysics to our hosts for the very great preparatory work they have undertaken in order to make us feel comfortable and to be among friends in this magnificent capital of the United States, but, particularly, we are grateful to the Local Organizing Committee for the great care taken on every point in order to further facilitate our work under your hospitable roofs.

Although this Congress is the seventh General Assembly of the Union, this meeting is the first to be held in the New World. Several of us have never been here before, although we have always been attracted to this country by its greatness and by admiration for what has been done here. Never could fate have guided the Union better than in leading us to meet just this time in the New World, where, thanks to your careful and thoughtful arrangements and with the help of so many distinguished American colleagues, the Union can carry through the great program for scientific work, drawn up by the Associations, in spite of the gales which sweep the world.

However, we all strongly feel that the American Organizing Committee merits more than words of thanks for what the committee has done in order to receive and help us. The most adequate expression of our gratitude would be not words but useful results from the discussions and the deliberations of the forthcoming days. It is our sincere hope that the results of this meeting may be so fertile for the growth of the sciences of geodesy and geophysics that this Washington Assembly will stand forever in the history of the International Union as a meeting of outstanding importance.

You will also allow me, in my capacity as president of the union, at this inauguration of the General Assembly, to thank all delegates and guests of the International Union present to-night, for having listened to the call and to welcome them to the meetings of the union and of the associations. Especially, I heartily welcome the great number of American colleagues who take part in our assembly at a very critical moment and fill out our ranks in such an excellent way. It is the hope of the International Union that our American colleagues who now for the first time attend a meeting of the union, will enjoy making our acquaintance as we enjoy their presence and are interested in their work and counsel.

I also wish on this occasion to send a friendly greeting to those of our colleagues who, on account of the unfortunate conditions in the world, are prevented from being present here. We know that wherever they are, at home or on their way back from here, every one of these distinguished men will look forward with longing to meet us again as we are longing for the moment when we can join them again and resume friendly and fruitful cooperation.

But there are some colleagues whom we shall never meet again. I beg you to rise from your seats, my dear colleagues, in commemoration of Professor Charles Lallemand who died 18 months ago after a long and active life. We shall always feel deep gratitude towards Lallemand, the founder of this union, for what he did when among us, and we heartily wish that the spirit and enthusiasm of this noble man of science may stand as guiding stars before the army of the union. Honneur soit à sa mémoire! Thank you.—

Many other colleagues have passed away since the last meeting of the union. The associations with which their work has been connected will individually recall their labors. On this occasion we remember with reverence all these who have passed away after lives devoted to the search for truth.

Since Benjamin Franklin undertook the truly dangerous, but permit me to say local experiment in Philadelphia, in order to try whether it was possible by means of a kite to fish the mysterious electric spark out of a thunder-cloud, and up to the present day when cosmic rays of still unknown origin are caught in strong American steel bombs, not only locally in America but also in other countries, the whole world knows that geophysical work made *in* America, or elsewhere *by* Americans, has been one long uninterrupted and always increasing activity of the greatest influence upon the development of both geophysics, pure physics and allied sciences, and for the opening of the fountains of the earth's riches.

The activities of the United States of America in geophysics have not been limited to investigations of electricity of the atmosphere; the exertion of energy has spread over all branches of geophysics and over geodesy, and the advancement of the whole of these sciences in other countries rests to a very large extent on discoveries and progress first made in the United States of America. Our host, the American Geophysical Union, is an ideal model of a body for coordination of researches. The American union is by far the greatest of the National Committees which have joined the International Union of Geodesy and Geophysics. The list circulated shows that the number of members of the American Union is no less than 1,095. Only a great country, the soul and power of which are based

upon the pleasure of its inhabitants to unite their forces, can raise and maintain such an army of scientists and provide this army with instruments and other expedients necessary for working in the first line on all fronts. The regular reports of the American Union, recording the activities of Americans, are generally recognized as a most valuable source of information and stimulus to the whole world. In other countries we can admire your Union, but never reach you on this point. The International Union of Geodesy and Geophysics heartily congratulates the United States on having this army, as the Union congratulates itself upon its close collaboration with this efficient American organization. The collaboration, on an equal footing, of the American Union with National Committees even of small countries, is a remarkable evidence of real brotherhood between nations.

When I spoke to you about Franklin's historical experiment with his kite and about the strong American steel bombs for catching cosmic rays in various places on the earth, I referred to the expansion over the world of the spiritual forces of the United States. It is just as reasonable when foreign scientists meet in your country to remember also the great material support which over and over again has been given by America to assist science in other countries. This readiness of American institutions to further scientific activity wherever in the world science is germinating, has often meant a great stimulation to scientists, and many flowers grown abroad adorn the name of this nation, which has risen above the narrow walls of egoism in order to help other nations to attain prosperity and health through science. From my own field of work I can testify to the great encouragement it meant to numerous countries taking part in the undertaking known as the "International Polar Year" some years ago when institutions and men of science of the United States joined the work and took a leading part in it. Similar personal testimony as to precious help in other scientific fields of work generously extended to other countries by the United States, could be given by many other colleagues present here to-night and by a still greater number of those working in other branches of science.

Naturally, in declaring this seventh General Assembly of the International Union of Geodesy and Geophysics to be opened, I must refer to the actual unfortunate political situation.

Dark clouds have shadowed for a time the sunshine in which the union would like to work. During these very days of our meeting we have had sad evidence of the use of man's knowledge for the injury of human beings and the devastation of civilization. But it is a profound reason for great encouragement to know that truth, friendship and mutual understanding are germinating and growing within the walls of the union whether the sun shines or not. Truth, friendship and mutual understanding are all precious fruits of human virtue, and they are just the medicinal plants the world needs for its sickness that it may become the bright home for mankind, and for peace we all would like to see. Scientific work is work done for the benefit of all peoples, and the union labors to increase that common fortune. At this very moment there are on each sides of the frontiers between fighting countries remarkable men, our colleagues, who are near friends, who continue to collaborate and who pay homage to the same truths. By proceeding along that path, common sense and brotherhood among the peoples must ultimately rule the world. During the coming days we shall remember with satisfaction that colleagues and friends, prevented from taking part in the assembly, will direct their eyes with sympathy towards our meeting and share our wishes for the success of the congress to the benefit of all.

No gloomy cloud is everlasting, and at this festival occasion it is well also to rejoice in the role the union has to play. I shall not go into details, for one thing because the work in the seven associations will be elucidated in presidential addresses during the coming days. Nor are details necessary to indicate the importance of international collaboration within geodesy and geophysics. The field of work of the union is not limited to the very thin shell round the globe where life is possible. The interests of the union stretch down through the deeps of the oceans, down to the sea-bed, and still further through fiery masses right to the center of the earth. Our interests also stretch upwards far beyond the blue of the sky, up into the crystal heavens where billions of ions are produced in bright sunshine and swarm by day as by night under the stars of heaven. Which empire on the earth rules these regions? Which empire rules the winds and the drifting clouds? Only organized international scientific collaboration can solve the problems of this marvelous globe.

The future of the union is bright because great results lie on our way. Modern science and technique have devised valuable instruments for our work, and their results are more wonderful than even authors of fairy-tales could have imagined. Not very many years ago, tedious and troublesome mountain ascents were necessary to gain but a slight knowledge of the temperature and humidity of the air at a few kilometers height. Nowadays it is possible with radiosondes to measure in less time than an hour those meteorological elements from the ground upwards to the air-streams flowing far above the highest mountains, and to get such measurements in the atmosphere made not only in places where mountains can be found and climbed but everywhere, also over the oceans; geodesists and seismologists can now get time-signals by wireless to

a hundredth of a second wherever they are on the earth; high-going planes carry photogrammetrical instruments of high standard for quick and exact mapping of even the most inaccessible regions; naval submarines can do peaceful geophysical work under the waves of the seas and give information about the material below the oceans; seismologists have found improved instruments for exact records of the moments of the earth's crust and of the earthquakes, the sound-waves of which pass through the interior of the earth and reveal the inner structure and properties of the globe—somewhat as a doctor does when he examines the inner organs of a human body by means of his stethoscope. Instruments for counting in less than a second how many ions swarm in each cubic centimeter of the air several hundred kilometers above our heads, and methods of analyzing the properties of large and small ions or even of small subdivisions of these ultra-microscopic particles, have been made available; certainly the tools which geodesists and geophysicists have to work with nowadays are not only useful, they are simply wonderful.

And now, gentlemen, the union is going to take up its pleasant work. We shall enjoy and profit from the personal contact with each other, we shall unite our forces in the study of scientific problems pertaining to the welfare of the 2,000 millions people who now live on the earth and of the unknown millions who will follow us, we will in a time of trouble give an example of the great value of collaboration among men, we will contribute to the conquest for mankind of the bounties of this beautiful earth, handsomely decorated as it is with radiant crowns of polar lights, with deep blue oceans, and with snow-covered volcanoes raised on its surface as signs of the fervency of its interior and as memorials of the birth of our star.

Expressing once more our most hearty thanks to our hosts for their hospitality and for the excellent arrangements of this meeting, and conscious that the union is now, *as ever,* going to work for truth, friendship and mutual understanding, I have the honor to declare this congress, the Seventh General Assembly of the International Union of Geodesy and Geophysics, to be opened.

La Septième Assemblée Générale de l'Union Géodésique et Géophysique Internationale et ouverte!

OBITUARY

WARREN PLIMPTON LOMBARD

ON July 13 America lost one of her early leaders in the field of physiology, for Warren Plimpton Lombard was among the small adventurous group who introduced experimental physiology to this continent. With that same death was lost a leader in humanity, for Dr. Lombard stood head and shoulders above his fellows in the better traits of man. He was truly a great gentleman.

A son of Israel and Mary Ann Plimpton Lombard, both descendants of early New England settlers, Dr. Lombard was born at West Newton, Mass., on May 29, 1855. It was here that he grew up and received his preparatory education in the Boston and West Newton public schools. This period of Lombard's life was a happy one, for his father had vowed that no son of his would experience the pangs of sorrow of his own childhood. This early training in happiness became a philosophy of Lombard's and guided him in his later life.

In 1878 he graduated from Harvard and continued there three years longer to receive his medical degree. Lombard realized how meager the facilities of this country were for physiological investigation and left for Europe to work in the laboratory of Ludwig. Three years later he returned to America to accept an assistantship in physiology in the College of Physicians and Surgeons in New York City. He left again for a short period of study abroad and then returned to become assistant professor of physiology at Clark University in 1889. In that same year Henry Sewall, who was then professor of physiology at Michigan, departed for the more friendly climate of Colorado. William Howell took Sewall's place. In 1892 when Howell accepted the professorship of physiology at the newly organized Johns Hopkins Medical School, Lombard was called to fill the chair of physiology at the University of Michigan. Here he remained in active charge for a period of 31 years, when he retired.

Dr. Lombard's appointment at Michigan was an important one, as may be gathered from his account of Henry Sewall and the department of physiology:

> When Sewall came to this university the whole method of teaching physiology changed. Not only did he know the subject as it is taught in the textbooks, but he was thoroughly acquainted with the most advanced methods of physiological investigation. . . . Nor did Sewall neglect the laboratory side of the subject. In the catalogue of 1884–1885 we read: "The equipment of the physiological laboratory contains most of the more essential instruments used in physiological demonstration and research." Then follows a list which is quite imposing, an equipment which was greater than that of any laboratory in the country, with the exception of the older laboratories of Harvard Medical School and the biological departments of Johns Hopkins. . . . This was the first laboratory course in physiology offered in any medical school in the country.

Under Lombard's directorship of the department

there were many changes, for physiology was prospering. With the growth of the Medical School at Michigan the physiology department was moved to larger quarters, which it shared with pharmacology. In this building Dr. Lombard's ingenuity stood him in good stead in developing an effective equipment for teaching and research. Lombard's main contributions were in the field of muscle and nerve physiology, reflexes, particularly the knee-jerk, the finer mechanics of muscles, tendons and joints in coordinated contractions, blood pressure, the pulse and the cardiac cycle and sensory endings. One of Lombard's first pieces of research appeared from Ludwig's laboratory in 1885. It dealt with the sequence and strength of contraction of the muscles of the lower extremity of the frog following on various forms of irritation applied to the skin. The simultaneous recording of contractions of as many as twenty muscles with the aid of a most ingenious mechanical system led to significant findings on the integration of spinal reflexes. Later studies of a purely mechanical nature complemented his earlier finding on nervous integration and revealed many unexpected uses of muscles, *e.g.*—"The fact that a two-joint muscle can make use of the tendon action of another two-joint muscle on the opposite side of the leg accounts for the paradox that a two-joint muscle, when in a position to have a stronger extensor than flexor leverage, may extend a joint of which it is a flexor." These studies were followed by the construction of models showing various complicated actions of two-joint muscles. Lombard was the first to construct a sensitive balance large enough to record the minute changes in weight accompanying each respiratory act in man, a method of investigation which has proven to be of value and of continuing promise. Another outstanding contribution was the visual inspection of the capillary circulation of man, a forerunner of innumerable important investigations in the field of circulation. The topographical localization of sensory endings in the skin with tattoo marks and plaster of paris impressions and their later identification at the original location is a striking example of the precision of his methods.

Historically Lombard's name will always be linked with American physiology. He not only brought the newer methods of investigation from abroad, but he was one of the charter members of the American Physiological Society. These incidents in his life were of unending satisfaction to him.

Dr. Lombard was married to Caroline Cook, of Staten Island, N. Y., on June 21, 1883. She died in 1923, the year that he retired. Her death was a great blow to him. He dropped physiology. He gave his valuable library to the Department of Physiology, set aside sufficient endowment to continue the subscriptions to the journals and turned his thoughts to art—drawing, water color and etching. Etching was his favorite, which he mastered with extraordinary ability. Those of the art colony at Monhegan, Maine, who saw his work each summer marvelled at his progressively increasing skill. Those who knew of his experimental ability understood. His work was shown in general exhibits and in one-man shows. In his later years art became his absorbing interest.

Friends who had the good fortune to know Dr. Lombard intimately will never forget his friendly and generous nature, which remained with him to his very last days. In "The Musings of an Old Man," written at the age of 84 and presented to a small scientific club at the University of Michigan, he makes the following statement:

> I have always been an optimist, and I can not claim to have ever been religious. I have thoroughly enjoyed life and feel that the finest one can do is to bring pleasures into the lives of others. In this I find a worthy reason for living, and shall be glad to live as long as I can enjoy life and help others to do so.

To those who admit the mechanistic forces of life and have faith in evolution, men like Warren Plimpton Lombard shine as rays of hope for the future happiness of mankind.

ROBERT GESELL

UNIVERSITY OF MICHIGAN

RECENT DEATHS

DR. HARVEY CUSHING, Sterling professor of neurology at Yale University from 1933 until his retirement with the title emeritus in 1937, died on October 7 at the age of seventy years. Dr. Cushing was Moseley professor of surgery at Harvard University from 1912 to 1932, when he was made Moseley professor emeritus.

DR. CHARLES STAPLES MANGUM, successively professor of physiology and materia medica, pharmacology and anatomy and from 1933 to 1937 dean of the Medical School of the University of North Carolina, died on September 29. He was sixty-nine years old.

DR. OSCAR HENRY PLANT, professor of pharmacology and head of the department at the State University of Iowa, died on October 2 at the age of sixty-four years.

DR. E. VICTOR SMITH, professor of physiology at the University of Washington, died on September 28 at the age of seventy-two years.

PROFESSOR JOHN RAYMOND LAPHAM, dean of the department of engineering of George Washington University, died on October 3 at the age of fifty-three years.

F. L. MUSBACH, professor of soils in the University of Wisconsin, who had charge of soil investigations at

the branch experiment stations, was killed in an automobile accident on September 14. He was sixty-three years old. Professor Musbach was a member of the American Association for the Advancement of Science and other scientific societies.

DR. CHARLES JASTROW MENDELSOHN, of the College of the City of New York, cryptographer, known for his work on the mathematics of code-word structure and the theory and structure of the cable codes, died on September 27 at the age of fifty-eight years.

SCIENTIFIC EVENTS

THE ARNOLD ARBORETUM EXPEDITION TO NORTHWESTERN CANADA

THE Arnold Arboretum expedition of 1939 to the Mackenzie basin of northwestern Canada returned to Boston on September 28. It left for the field on May 20, and arrived on June 9 at Fort Simpson on the Mackenzie River. On June 16 a chartered airplane was used for the journey to Brintnell Lake, approximately 200 miles west of Simpson. This lake lies at about 2,600 feet above sea-level and is surrounded by mountains ranging from 6,000 to 9,000 feet above the sea. Its position is in lat. 62° 5′ N., long. 127° 35′ W. The party remained there until August 20, when they returned to Simpson by plane. The boat journey southward was begun on September 8.

Approximately 1,000 field numbers of vascular plants, 620 of lichens and 60 of fungi, altogether about 15,000 herbarium specimens, were collected, mainly at Brintnell Lake and in the vicinity of Fort Simpson. The chief objectives of the trip were collections and notes on local vegetation in the Mackenzie Mountains of the South Nahanni River region, in which Brintnell Lake is situated. The lake is at the margin of the Snyder Range, a group of high mountains about the headwaters of the South Nahanni, and lies in one of the least known regions, biologically speaking, in boreal America. In fact, practically no botanical material from the whole Mackenzie Mountain system had been collected prior to this summer; and it was especially desirable in view of projected plans for a new floristic work on the northern parts of the continent.

The 1939 expedition was supported by the Arnold Arboretum and by liberal grants from the Milton Fund of Harvard University, the American Academy of Arts and Sciences and the National Academy of Science. The National Museum of Canada contributed substantially by the loan of field equipment. The party consisted of Dr. and Mrs. Hugh M. Raup, their two sons and James Soper, of Hamilton, Ontario.

HUGH M. RAUP

THE BISHOP ORNITHOLOGICAL COLLECTION

THE Field Museum of Natural History, Chicago, has recently concluded arrangements to acquire the Bishop collection of more than 50,000 North American birds, one of the largest and most important private collections ever assembled and the last of its kind which had not passed to a public institution. The negotiations to obtain this collection were recently completed by Dr. Wilfred H. Osgood, chief curator of the department of zoology, on a visit to Dr. Louis B. Bishop at Pasadena, California. Dr. Osgood is an old friend of Dr. Bishop's, and in 1899 they conducted an expedition together to the Yukon and Alaska.

The Field Museum will obtain possession immediately of the major part of the collection, which is now housed at New Haven, Conn. The rest of it will remain in Los Angeles, where Dr. Bishop will continue work towards its improvement. It includes representatives of nearly all known forms of birds found in every section of North America north of Mexico, representing forty years of constant and intensive effort, both on the part of Dr. Bishop and of numerous professional ornithologists who have been associated with him at various times. According to Rudyerd Boulton, curator of birds at the museum, the specimens are distinctly superior to the average in quality of preparation. An important item is the inclusion of thirty type-specimens. Included also are specimens of various birds which are now extinct, such as the Carolina parokeet, the ivory-billed woodpecker, the Eskimo curlew and the passenger pigeon. Many others are of species which have become scarce and difficult to obtain.

Hitherto the principal efforts in ornithological research made by the museum have been devoted to the birds of Central and South America, Africa and other foreign localities. Although it has a collection in the North American field, this has been left largely to other institutions. The acquisition of the Bishop collection now gives to the museum one of the most comprehensive North American bird collections either in this country or abroad. It is estimated that it has cost its owner nearly $100,000, and it is doubtful if it could be reproduced at this time for double this amount.

THE LALOR FOUNDATION FELLOWSHIP AWARDS

THE Lalor Foundation has announced its fourth series of fellowship awards, authorizing grants of $20,000 for the academic year 1940–41. The individual awards range between $1,800 and $2,500 or according to the special needs of the candidate.

Six fellowships of the 1939–40 series are being ad-

ministered by the foundation, which was organized in 1935. The work of the holders of present fellowship awards is in the fields of physical chemistry, biochemistry and biophysics, and the institutions at which the researches are being conducted include the University of Oxford, Cornell University, Princeton University, the Johns Hopkins University, the Massachusetts Institute of Technology and the Johnson Institute of Biophysics of the University of Pennsylvania. The present war has caused almost complete abandonment of fundamental research in the belligerent countries, but the fellows who originally planned to work abroad have been able to make other plans for the coming year.

The awards in the 1940–41 series will be given for fundamental research work in any field of chemistry. Support for industrial research is not intended. The awards are open to both men and women and for work anywhere in the United States or abroad. Men and women in academic service who may be on leave of absence are among those eligible for appointment. Attainment of the degree of Ph.D. or training equivalent thereto is a requirement for candidacy. The final selections will be based on previous training, demonstrated competence and the promise of the candidates in their special fields of work.

It is pointed out in the official announcement that one of the important needs in science is to develop men who have a thorough background and training in fundamental chemical research and who have also adequate experience in the biological and medical sciences, qualifying them to attack with basic understanding research problems in the fields of biochemistry and chemotherapy. Accordingly, for a part of the Lalor awards, preference will be given to candidates directing their research toward applying the principles and discoveries of physical and organic chemistry to problems within these latter fields.

The qualifications of candidates will be passed upon by a selection committee consisting of Drs. C. A. Kraus, of Brown University; Arthur B. Lamb, of Harvard University; Roger Adams, of the University of Illinois; Hans T. Clarke, of Columbia University, and the secretary of the foundation.

Inquiries and requests for application forms for awards should be addressed to C. Lalor Burdick, Secretary, Lalor Foundation, Wilmington, Delaware. Applications should be in his hands by December 31, and appointments will be announced early in March, 1940.

SYMPOSIUM ON CRYOGENIC RESEARCH OF THE AMERICAN CHEMICAL SOCIETY

ON September 11, the week of the Boston meeting of the American Chemical Society, the Division of Inorganic and Physical Chemistry sponsored a symposium on Cryogenic Research, held at the George Eastman Laboratories of the Massachusetts Institute of Technology. It was at the Rochester meeting two years ago that the first symposium held in the United States for the presentation of papers and discussion on low temperature methods and research took place. The recent meeting furnished convincing evidence of an astonishing increase in interest, equipment and volume of research over the two-year interval. Our scientific colleagues from the Cryogenic Laboratory of the University of Toronto, H. Grayson Smith and J. O. Wilhelm, contributed two papers, and the Mond Laboratory of Cambridge, England, was represented by Dr. D. Shoenberg, who contributed a paper on super-electrical conductivity. Papers were presented also by representatives of the cryogenic laboratories of the National Bureau of Standards (F. G. Brickwedde, R. B. Scott, H. J. Hoge), the University of California at Berkeley (W. F. Giauque and J. W. Stout), the Pennsylvania State College (J. G. Aston and G. H. Messerly), the Johns Hopkins University (W. T. Ziegler), the California Institute of Technology (Alexander Goetz and A. Dember), Columbia University (H. A. Boorse, V. W. Cohen, C. Williams, S. L. Quimby), Cornell University (J. G. Kirkwood) and the Massachusetts Institute of Technology (S. C. Collins, R. B. Jacobs, C. Starr, C. C. Stephenson, J. G. Hooley, J. A. Beattie, B. E. Blaisdell, J. Kaye, C. A. Johnson and H. T. Gerry).

The symposium was in part devoted to the consideration of techniques and methods adapted to improving the precision and scope of a wide range of types of measurements at the lowest temperatures. The bulk of the day, however, was occupied with reports on the peculiarities of the heat capacities and thermodynamic properties of a variety of substances, the velocity of sound in liquid helium, its viscosity and flow peculiarities, phase transitions of the second kind, electrical superconductivity as related to conductor size, x-ray reflection intensities, thermal and magnetic properties of the para-magnetic salt nickel sulphate heptahydrate, among other items.

Professor Alexander Goetz gave a survey drawing attention to the remarkable advantages for many purposes which the special properties of matter at very low temperatures possess. The low temperature preservation of cell life, for example, should be of immediate practical interest in preserving many kinds of cells—blood corpuscles of varied types, for instance.

The most serious present obstacle to the rapid development of a more detailed and profound knowledge of the properties of matter and associated phenomena lies in the expensive equipment and the danger attending the manipulation of hydrogen and gases generally under high pressure. In this connection the report by the Massachusetts Institute of Technology group (S. C. Collins and R. B. Jacobs) of progress in the attempt to develop inexpensive mechanical means for continuously maintaining sub-hydrogen tempera-

tures was of general interest. If the difficulties of design and operation of a really low temperature engine (10° K level) can be solved, a substantial advance will have been made in promoting the conditions for larger scale and safer operations in a fascinating world of strange and as yet imperfectly understood phenomena.

The enthusiasm and greatly widened interest manifest throughout the course of the symposium warrant the belief that the United States in a very short time will be contributing cryogenic research results commensurate with the resources of the country.

F. G. KEYES

SCIENTIFIC LECTURES OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

THE first of the annual scientific lectures of the College of Physicians of Philadelphia was the Mary Scott Newbold lecture XLV, which was given on October 4 by Dr. Alfred Blalock, professor of surgery at Vanderbilt University. He spoke on "Shock."

The lectures for 1939 to 1940 are given at 8:30 P.M. on the first Wednesday of each month from October to May. The program follows:

November—James M. Anders Lecture XIV. Rolla E. Dyer, chief, Division of Infectious Diseases, U. S. Public Health Service. "Animal Diseases Transmissible to Man, with Special Reference to Typhus Fever, Spotted Fever, Undulant Fever and Tularemia."

December—Thomas Dent Mütter Lecture LII. Howard T. Karsner, professor of pathology, director of Institute of Pathology, Western Reserve University. "Certain Ovarian Tumors Associated with Sexual Endocrine Dysfunction."

January—James M. Anders Lecture XV. Charles Armstrong, senior surgeon, U. S. Public Health Service. "Recent Developments in Central Nervous System Virus Infections, with Special Reference to Lymphocytic Meningitis and Poliomyelitis."

February—Mary Scott Newbold Lecture XLVI. Tom D. Spies, associate professor of medicine, University of Cincinnati. "Clinical and Laboratory Studies on the Avitaminoses, with Special Reference to Nicotinic Acid, Thiamin and Riboflavin."

March—Mary Scott Newbold Lecture XLVII. Alvin F. Coburn, assistant professor of medicine, Columbia University. "Factors in the Initiation of Rheumatic Activity."

April—Balduin Lucké, professor of pathology, University of Pennsylvania. "Tumors in Cold-Blooded Animals; Their Significance in the Experimental Investigation of Cancer." Joseph McFarland, emeritus professor of pathology, University of Pennsylvania. "The Pathological Diagnosis of Cancer in Man."

May—Nathan Lewis Hatfield Lecture XXIII. Lecture and subject to be announced.

The following lectures for the general public are announced:

November 17, 1939—O. H. Perry Pepper, professor of medicine, University of Pennsylvania. "Medical Problems of Advancing Age."

January 19, 1940—J. Parsons Schaeffer, professor of anatomy and director of the Daniel Baugh Institute of Anatomy, Jefferson Medical College. "The Human Constitution and Some of Its Problems."

April 12—W. Edward Chamberlain, professor of radiology and roentgenology, Temple University. "The X-Ray as an Aid in Diagnosis."

MEDICAL EDUCATION AT THE UNIVERSITY OF CHICAGO

DECISIONS affecting medical education on the west side of Chicago have been announced by President Robert M. Hutchins, of the University of Chicago, and John McKinlay, president of the Board of Managers of the Presbyterian Hospital. The university has decided to terminate undergraduate medical education at the Rush Medical College. The Board of Managers of the Presbyterian Hospital has voted that the hospital remain as at present on the west side of Chicago.

As a result of these decisions, the university will establish a program of graduate medical education at the Rush Medical College and committees will be appointed to formulate plans for a Graduate School, which it is hoped will be opened in the near future. It will emphasize research in medical science and provide training for graduates of medical schools in the various fields of specialization.

Undergraduate work will continue, however, at the Rush Medical College till July, 1942, to provide completion of training for the class entering next autumn. Undergraduate training also will continue at the south side medical school and after 1942 will be offered there exclusively.

The decision to establish the Rush Medical College as a center of graduate medical training terminates discussions as to its ultimate status which have been carried on intermittently since 1916. In that year the university approved plans for the south side school, which was opened in the autumn of 1927.

Rush Medical College, chartered in 1837 and in operation since 1842, was the pioneer medical school of the Middle West. It was merged with the university in 1924 after twenty-six years of affiliation.

GRANTS IN AID OF RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AT its annual meeting each year the council of the American Association votes a number of grants in aid of research. In order that applications for such grants may be examined and passed on by the committee on grants in time for the annual meeting, they must be filed in the office of the permanent secretary

before November 1 on forms that will be supplied upon request. These forms contain full instructions respecting the information that must support the applications.

The funds from which the grants are made are derived from the income of endowments of the association by various gifts, from investments of reserve funds and from the income from the life membership fees of deceased life members. Although the income available for the support of research is as yet very limited, it fortunately has been increased in recent years by gifts from a friend of the association.

As a rule grants are not made to pay salaries investigators or traveling expenses or for printing ports of the results of investigation. They are g erally made for assistance in completing resea projects that are well under way and for which v able conclusions within limited periods may reas ably be expected. Often they complete the requ ments for funds which have been partly met by t institutions with which the applicants are associa or from other sources.

F. R. MOULTON,
Permanent Secretary

SCIENTIFIC NOTES AND NEWS

AT the meeting of the National Academy of Sciences to be held at Brown University, Providence, R. I., on October 23, 24 and 25, there will be three general addresses. At 4:30 on the afternoon of October 23, Dr. Frank B. Jewett, president of the academy, will give an address over the coast to coast network of the Columbia Broadcasting System on "How Science Could be Mobilized in the United States." In the evening, Dr. Harvey Fletcher, of the Bell Telephone Laboratories, will give a public lecture on "Auditory Patterns—a Demonstration Lecture." At the dinner on the evening of October 24, Dr. Albert D. Mead, of Brown University, will speak on "Episodes and Personalities in the Development of Biology at Brown."

THE eightieth birthday of John Dewey, which occurs on October 20, will be celebrated on October 20 and 21 by a conference at the Hotel Pennsylvania, New York City, under the auspices of the Progressive Education Association. There will be fourteen sessions, in which many leaders in philosophy and education will participate.

DR. GANO DUNN, president of the J. G. White Engineering Corporation and of Cooper Union, has been chosen as the 1939 recipient of the Hoover Medal, "awarded by engineers to a fellow engineer for distinguished public service." John V. W. Reynders, of New York, is chairman of a board of award representing the four national societies of civil, mining and metallurgical, mechanical and electrical engineers. "The medal signalizes great unselfish, non-technical service by engineers to their fellowmen." It will be formally presented to Dr. Dunn under the auspices of the American Institute of Electrical Engineers during the annual convention in New York City on January 22 to 26, 1940.

THE Roosevelt Memorial Association has awarded one of its Roosevelt Medals to Dr. George Washington Carver, of the Tuskegee Institute, distinguished for his work in agricultural chemistry.

DR. C. B. HUTCHISON, dean of the College of Agriculture of the University of California at Berkeley, has been awarded the degree of doctor of agriculture *honoris causa,* by the University of Sofia, Bulgaria. The degree was awarded on the occasion of the fiftieth anniversary of the founding of the university. Dean Hutchison received the honor in recognition of the aid he gave to the university from 1924–27 while acting as a member of the European Mission of the International Education Board of the Rockefeller Foundation.

DR. PETER DEBYE, professor of physics at Berlin, has been elected honorary member of the Indian Academy of Sciences at Bangalore, of the Chemical Society of the Netherlands and of the Physical Society, London.

A DINNER was given on October 12 by colleagues and former students in honor of Dr. Evarts A. Graham, since 1919 professor of surgery at the School of Medicine of Washington University, St. Louis.

DR. WARREN H. MCBRYDE, of San Francisco, Calif., has been elected president of the American Society of Mechanical Engineers. He will take office at the sixtieth annual meeting to be held in Philadelphia from December 4 to 8. This is the first meeting to be held other than in New York City since the year 1890.

DR. HARDY A. KEMP, professor of bacteriology and preventive medicine at the College of Medicine of Baylor University, Dallas, Texas, has become dean of the College of Medicine at the University of Vermont. Dr. Kemp is also head of the reorganized department of bacteriology, hygiene and preventive medicine.

DR. ROBERT S. SHANKLAND has been appointed acting head of the department of physics at the Case School of Applied Science. He succeeds Dr. Dayton C. Miller, who retired in June, 1938.

DR. CARL WALDEMAR HAGQUIST, who served as acting professor of biology at the University of Rich-

ond during the last session, has been appointed professor of biology at Albany College, Portland, Oregon.

DR. GERALD F. TAPE, graduate assistant in physics at the University of Michigan, has been appointed for the current year instructor in physics at Cornell University.

DR. ALFRED S. LAZARUS, of the Hooper Foundation of the University of California and of the Connaught Laboratories of the University of Toronto, has been appointed instructor in the department of bacteriology and public health at the University of Colorado School of Medicine at Denver.

DR. CLARENCE F. HISKEY has been appointed instructor in chemistry at the University of Tennessee. He will continue the research on rhenium in which he has been engaged at the University of Wisconsin.

DR. CHARLES F. ROGERS, assistant biochemist for the Minnesota Agricultural Experiment Station, has been appointed associate in biochemistry in the department of agronomy at the Ohio Agricultural Experiment Station at Wooster, to succeed Dr. Morris. He will continue in cooperation with plant physiologists on the biochemistry of corn.

ARTHUR FOLGER, since 1919 member of the Division of Animal Husbandry of the College of Agriculture at Davis of the University of California, has resigned to accept the post of regional director of the Farm Security Administration.

DR. ALFRED FRÖHLICH, formerly professor of pharmacology at the University of Vienna, has been appointed pharmacologist to the May Institute for Medical Research of the Jewish Hospital, Cincinnati, Ohio.

GORDON GUNTER, of the department of zoology of the University of Texas, has been appointed marine biologist for the Coastal Division of the Texas Game, Fish and Oyster Commission.

DR. J. H. SANDGROUND, formerly assistant professor of helminthology in the department of tropical medicine at the Medical School and the School of Public Health of Harvard University, has joined the staff of the Lilly Research Laboratories at Indianapolis. He has recently returned from the Netherlands East Indies where, as a fellow of the John Simon Guggenheim Memorial Foundation, he spent a year working in the Pathologische Instituut of the Geneeskundige Hoogeschool at Batavia.

DR. ARNE TISELIUS, professor of biochemistry at the Fysikalisk-Kemiska Institutionen, University of Uppsala, will deliver on October 19 the first Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "Electrophoretic Analysis and the Constitution of Native Fluids."

DR. A. A. BITANCOURT, sub-director of the Institute of Biology, São Paulo, Brazil, gave three lectures at the Iowa State College on October 2, 3 and 4. The titles of his lectures were: "The Influence on Agriculture of Destructive Insects and Plant Pathogens in Brazil," "The Coffee Borer and Its Control in the State of São Paulo" and "The Elsinoaceae as Plant Parasites in Brazil."

IT is reported that Rear Admiral Richard E. Byrd will sail for the Antarctic about November 1 despite the withdrawal of one of his three vessels by the Government. The decision to keep the cutter *Northland* in home waters during the foreign crisis will necessitate a change in the plan of the expedition. The *Northland* was to have accompanied the *North Star* to New Zealand and then to Little America, while the old barkentine *Bear* put in at Valparaiso to pick up supplies. It will now be necessary for the *Bear* and the *North Star* to go to New Zealand and Antarctica first and then to return to Valparaiso to get the equipment and personnel waiting there.

IT is announced in the *British Medical Journal* that owing to the war there will be no annual meeting of the British Medical Association in 1940. It was to have been held at Birmingham.

Science Progress, which is issued quarterly and which is now in its thirty-fourth volume, has suspended publication on account of war conditions.

IT is reported that Germany is closing all but four of her universities; they are Berlin, Vienna, Munich and Jena.

APPLICATIONS are being received for Benjamin Peirce instructorships in mathematics at Harvard University for the academic year 1940–41. Candidates should ordinarily have the doctorate or its equivalent. Applications should be sent to, and further information may be received from the chairman of the department of mathematics.

THE City Service Commission of Milwaukee will hold an examination for the position of curator in "lower zoology" in the Milwaukee Public Museum to fill a vacancy caused by the retirement on pension of Thomas E. B. Pope. It will consist of a questionnaire in training and experience and in the submission of exhibits, particularly scientific publications. Candidates must have had at least one year of experience in a museum and at least three years of experience in either a museum, university, scientific bureau or other institution. The position is open to men only.

THE second annual instrumentation contest with a first prize of $200 is announced by the Industrial Instrument Section of the Scientific Apparatus Makers of America. Twelve prizes in all, amounting to $500, will be awarded. The contest is open to any person

not employed by an instrument manufacturer. Two themes are specified: instruments save money; instrumentation makes jobs. The contestant is to submit either an original report or an original essay in support of either theme. No manuscript should cover both themes. The contest will be judged by the following Jury of Award: M. F. Behar, editor, *Instruments;* C. S. Redding, president, Leeds and Northrup Company; H. B. Richmond, treasurer, General Radio Company; P. T. Sprague, president, The Hays Corporation, and chairman, Industrial Instrument Section S. A. M. A; L. G. Wilson, president, Precision Thermometer and Instrument Company; F. K. Taylor, vice-president, Taylor Instrument Company; Clemann Withers, treasurer, Sperry Gyroscope Company. The contest closes on November 15, 1939, and the judging will be held promptly. Copies of the rules of the contest and of the official entry forms can be obtained from the Scientific Apparatus Makers of America, 20 North Wacker Drive, R.3014, Chicago, Ill.

THE twelfth annual Science and Engineering Fair of the American Institute of the City of New York will be held in 1940 from April 14 to 20, inclusive. Ten thousand students of science are members of the institute. All exhibits are the actual creations of the student participants, and cash prizes amounting to more than two thousand dollars will be awarded for the best displays. Working models, experiments, live animals and plants, technical and mechanical projects and miniatures are but few of the types of exhibits which have been designed and executed for this year's fair. It is the annual fair of New York County, a continuance of the annual industrial fairs of the institute which began in 1828.

THE United States Sugar Corporation at Clewiston, Fla., has made a gift of $1,000 to establish the Napoleon B. Bernard Fellowship for research at the University of Florida. This marks the fourth gift by the organization to the university since 1937, the others being a similar $1,000 fellowship and two $2,000 scholarships. The new fellowship provides awards for "graduate study of the soil, climate and agriculture of the Everglades."

DEARBORN OBSERVATORY of Northwestern University is being moved 600 feet south and east to clear the site for the erection of the new Technological Institute. Under the direction of Dr. Oliver J. Lee, chairman of the department, astronomers at the university have stored the telescope lenses in underground vaults, lashed the telescope to the walls and moved the most delicate instruments out of the building. The 125-ton brick pier on which the telescope rests will be moved with the building. Using 700 jacks, each of 25-ton capacity, the entire structure has been raised about three feet, placed on rollers, and is being taken away on tracks, using two teams of horses and a tractor. Test borings indicate tha the new site of the observatory is directly over an old creek bed, which will give the building a firm foundation on a dense clay substratum.

DISCUSSION

THE ORIGIN OF THE HUMAN RACES

MANKIND may be divided into a number of races and, whereas various authors have different opinions about the question as to how many races there are, they are fairly unanimous in considering them to be the products of some natural force or forces. Presumably agencies similar to those responsible for the production of groups of nearly related species would be the cause of the human races.

It is a well-known fact that members of different races in all possible combinations may have fertile offspring. Therefore, there must be isolating factors which keep the races separated, as otherwise mankind would be a thorough mixture of a great many types, such as observed when studying a population, said to be of one race.

These isolating factors are thought to be natural, as opposed to human, in the same sense in which a house may be called a human and not a natural product, although in the last instance man, and all that which belongs to him, is part of nature. Here, in my opinion, a grave mistake is made. The human races are not maintained by an act of nature, but by human, that is, social, discrimination.

Proof for this lies in the nature of the qualities by which the races differ. They are all superficial and readily impress an untrained observer. The color of the skin, the shape of the eye or nose, the form of the hair which constitute the basis for the recognition of human races are visible to every one at the first glance and may therefore be subject to social selection. This causes their occurrence in large coherent sections of the human population.

The variations upon which the human races are based are by no means the only ones existing. Professor Komai has published a list of more than 80 inheritable variations common to the white race and the Japanese, although not occurring with the same frequency. Some of these, like color blindness, the presence of supernumerary fingers or toes and harelip are unobtrusive and free from social taboo. Others, like the blood groups, refer to inner organs or chemical substances and are invisible as such. None of

n could serve as basis for the distinction of a an race. There are color-blind people among all es, but there is no race of color-blind men, because out a scientific investigation no one is able to select mate in regard to this quality.

The human races, such as they are, would never e developed in nature in the absence of man's own al actions, the results of which are not restricted he differentiation between the major races of man- d. Differences between tribes, some of them count- only a few hundred individuals, are due to the same se.

The races of mankind are no less a product of man n the races of his dogs and horses. Here, too, a ain potential variability is a prerequisite for the tion of a number of races. In the case of the dog must have been present in the wolf and the other d species of carnivores which went into the crosses m which the various types of dogs were bred. This inal variability is natural and not due to human ion, but it need not show and may lie hidden in a paratively uniform animal like the wolf.

The origin of this primary variability need not be ussed at present and is, as yet, uncertain. Only, may be stated that the natural forces responsible this variation have not necessarily long ago ceased be active. There is reason to believe, for instance, t in man the character which is designated as blood up *A* has originated only a few thousand years ago. Whatever the nature of this primary variability it s not lead to a distinction between races, if not ompanied by isolation of the various types in one or another. Many recognize various environmen- factors, as, for instance, the climate, as such isolat- agencies. The various climates, it is said, would oduce the human races. However, it is not clear why climate would only affect the dispersal on earth of ible characters and not that of the more numerous aracters which are more or less invisible.

Each of the human races, if inhabiting the earth ne, might spread over a somewhat different area, d factors like climate, or physical barriers obstruct- migration, may have something to do with the regation of mankind into groups with different pes. But the social motives in regard to mate selec- n are much stronger than any motive to select a rtain climate or other environmental condition. nerally speaking, members of the white race are lling to live all over the earth, but not to marry into her races.

If the idea discussed above is correct the problem of human races is one to be more studied by sociolo- ts than by biologists. It also gives hope that race fferences will be viewed with less superstition and at race problems will be recognized as being more amenable to humane solutions than they appear to many at present.

A. B. Droogleever Fortuyn
Peiping Union Medical College

THE FLOATING POPULATION OF THE AIR

In my recent studies of the biota of the islands off the coast of Southern California I have found that the endemic insects appear to be mainly confined to certain groups, especially the more or less bulky Tenebrionid beetles, which can not fly. Excluding the species certainly or probably introduced by man, there is still a very large population of flying insects, as well as spiders, quite identical with species of the mainland. It might at first appear that these species were very constant in their characters, with little tendency to form distinct races or species when isolated. The true explanation, however, appears to be that they are constantly arriving through the air. The floating population of the air has not been sufficiently understood in the past, but the essential facts are admirably presented by Mr. P. A. Glick in his recently published work on "The Distribution of Insects, Spiders and Mites in the Air" (U. S. Department of Agriculture, Technical Bulletin 673, May, 1939). In this paper full details are given of the collections made by aeroplane in Louisiana and Durango, Mexico, the specimens secured having been carefully sorted and so far as possible identified. The work at Tallulah, Louisiana, involved 1,314 aeroplane flights, during which the insect traps were in operation for 1,007 hours. There were 44 flights in Durango, Mexico. In Louisiana, by day, 24,559 insects and arachnids were taken in 51,178 minutes. By night, 3,955 were taken in 6,790 minutes. Two hundred and twenty-five were taken in 2,455 minutes at altitudes over 5,000 feet; one spider at 15,000 feet. In Mexico, 1,294 specimens were taken in 2,120 minutes. There were numerous small wingless forms, carried upward by the air currents. All the various aspects of the work and its significance are most ably discussed by Mr. Glick, the bulletin extending to 150 pages. It is evident that the islands must be constantly receiving insects, spiders, and also spores and some seeds, through the air. Only a very small percentage of these can survive, but the constant supply enables the available environments to be populated, so that even recently introduced plants are often infested as they would be on the mainland. Thus at the Rancho Escondido, Sta. Catalina, I found the cocklebur, *Xanthium spinosum,* swarming with the trypetid fly which attacks it elsewhere. The introduced *Diaspis* scale of the prickly pear, at the same place, was infested by chalcidoid parasites. At the present time, the manner of arrival of the various species can only be guessed, but if the very numerous planes constantly flying about the islands could be utilized (with no in-

convenience to the service or the pilots) for studies like those of Mr. Glick, we should soon have a mass of positive information. We may leave it to mathematicians to calculate, on the basis of the work done, the probable number of insects in the air, but the figure must be surprisingly large. There is also another aspect of the matter, which I have not seen referred to. The sea in the vicinity of the coasts (how far out, we do not know) must be constantly receiving a rain of small arthropods, which must represent a not inconsiderable food supply for the marine animals.

T. D. A. COCKERELL

BOULDER, COLORADO

A REQUEST TO MATHEMATICAL GENETICISTS

THE lack of clarity in many papers dealing with theoretical genetics will probably retard to some extent the development of the science. Some of these are valuable contributions, but their merit is unnecessarily limited by the inadequate presentation of the mathematical materials. Much of the mathematics is simple algebra, but the lines of reasoning are frequently very hard to pursue, because many crucial equations are omitted. Sometimes lengthy and rather involved processes must be followed from one printed equation to the next, and there is not the slightest hint in the text as to what these processes are. Geniuses may have little difficulty with these papers, but such geneticists are scarce. Among the rank and file of animal and plant breeders one of the following courses is likely to be followed:

(1) The papers are ignored. Attempts to analyze a few of them bring the conviction that it is useless, and one can "get by" without them anyhow!

(2) The conclusions are accepted, but the reasons for them are not understood. It is obvious that such a state of mind is scientifically unsound.

(3) An enormous amount of time is expended in reading and analyzing the paper—very much more than would be required if a few crucial equations were added. A busy teacher is likely to give up through sheer need of sleep and revert to class (1) or (2)!

We teachers are training the geneticists of the future, and if we are not provided with reasonable opportunities for understanding the advances in mathematical genetics, such contributions may be to little known in the next generation. Genetics will not advance as it should. It is sometimes claimed that editors will not accept papers with too much mathematical material, for such printing is expensive. In reply, it may be said that there is little reason for publishing a paper if it is so brief that it can not be understood. Furthermore, mathematical clarity can usually be attained by adding such a small number of "clew" equations that the costs of printing would not be materially increased.

Biometricians should always remember that they are not writing for mathematicians, but for biologists who know the elements of mathematics, yet are not very familiar with many devices used in mathematical procedure. Please don't leave out so many equations!

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THE RANGE OF HEARING OF CANARIES

TESTS[1] on starlings, English sparrows and domestic pigeons show that the range of hearing of these birds is considerably more restricted than human hearing. Their ranges cover about five octaves; normal human hearing is about ten octaves.

The method used in testing the canaries was the same as in the earlier experiments. The investigation of the hearing of five birds was conducted by means of conditioned reflexes to a range of sound which during the conditioning of the experimental birds, has been followed by a mild electric shock from the feeding tray. The canaries' range was similar to that of the earlier birds experimented on but was even more restricted. Canary's range, 1,100–10,000 c.p.s., is only slightly over three octaves. Low and moderately high sounds are not heard. However, the bird undoubtedly hears all the sounds produced in its own song.

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SCIENTIFIC BOOKS

PLANE TOPOLOGY

Elements of the Topology of Plane Sets of Points. By M. H. A. NEWMAN. Cambridge: At the University Press; New York: The Macmillan Company, 1939, viii + 221 pp., 93 figs. $3.50.

ACCORDING to the publisher's jacket, this book "has the double purpose of providing an introduction to the methods of Topology, and of making accessible to analysts the simple modern technique for proving the theorems on sets of points required in the theory of functions of a complex variable." It is divided into two parts. The first, occupying slightly less than half the volume, opens with some calculus of abstract sets and investigates properties in metric spaces of closed and open sets, continuous mappings and connected sets

[1] A. R. Brand and P. P. Kellogg, 1939. *Wilson Bulletin*, 51: 38–41, 1939.

The second part is devoted specifically to the subject-tter indicated by the title and utilizes the "combina-rial" approach through cells and complexes selected om "gratings" formed by lines in the plane or sphere analytic geometry. The basic material is essentially elaboration and adaptation to the plane of a cele-ated paper of J. W. Alexander which appeared in *Transactions* of the American Mathematical Society 1922, but proceeds much further than such matters the Jordan Curve Theorem. For example, many the results of Schoenflies are derived, and a number the properties of plane domains to be found in the rk of American set-theorists are included. For the alyst, the author gives a proof of Cauchy's Theorem sed on the topological methods introduced.

The book is modern, well illustrated, very readable d typographically appealing. Numerous exercises e provided. The final 22 pages of the volume con-in supplementary bibliographical and mathematical tes and a good index. However, the bibliography ems weak; although in the case of some topics ade-ate references are given both to their origin and to eir more extensive treatments in the literature, in her cases such references are entirely lacking. It is be hoped that in a later edition this will be corrected what seems otherwise a work well suited to fulfilling e purposes stated.

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he Physiology and Pharmacology of the Pituitary Body. By H. B. VAN DYKE. Volume II. University of Chicago Press. Pp. xiv + 402. 28 figures. $4.50.

THREE years have elapsed since the appearance of e first volume of this series. In the first volume the thor reviewed and discussed the important work on e hypophysis from 1920 through part of 1935, though the background laid by earlier investigations as not ignored. In the new volume the literature for at part of 1935 not covered in the earlier volume and 936, 1937 and a part of 1938 has been reviewed. All apers relating to the pituitary gland that appeared uring this period are not included in the text or listed the voluminous (80 pp.) bibliography, however. he author has selected, as in the first volume, what emed to him to be the best and most informative of e publications. According to the author these con-itute 78 per cent. of the articles considered. This is severe but just indictment of recent endocrine litera-re. That even this percentage should be included is ue to the fact that the reviews were limited to the natomy, physiology and pharmacology of the pitui-ry body.

The text of this volume is only one hundred pages less than that of the first volume, although the period covered is but one fifth as long. An opportunity was thus afforded the author to be rather more critical in his comments than he was in the earlier work, and to add summaries at the end of each chapter.

The number of chapters has been cut from twelve to ten. This was accomplished by omitting the chapter on the effect of hypophysectomy and by devoting but one chapter, instead of two, to the physiology of the neural lobe. Otherwise, the chapter headings remain essentially unchanged. There are a generous number of illustrations, but none are used which appeared in volume I. They are well selected but, in contrast to the earlier book, are all copies from the literature. This has been an advisable change, in the opinion of the reviewer. A color plate is given to show the relationships of the cells of the pars glandularis. It might be questioned why a colored figure was necessary since the cell lineage given is identical with that described by Trautmann in 1912, whose description of cell relationships has been generally confirmed by cytologists.

The arrangement of the topics is logical and easily followed. Their range is broad, and includes, in addition to those which would obviously be discussed, topics such as the effect of the pituitary hormones and the chorionic gonadotropic hormones on neoplasms, the nervous control of the secretion of gonadotropic hormones, vitamins and minerals in relation to the gonadotropic hormones, to mention but a few. In the review of these subjects and in the chapter summaries an unprejudiced view-point is maintained and optimism in regard to the achievements of endocrinologists is notable by its absence. In regard to the number and action of the pituitary gonadotropic hormones, he holds that the only reasonable position to take is one of suspended judgment, unwelcome as this may be to many readers. He only provisionally and for convenience of discussion accepts a specific "growth-promoting" hormone. Yet he freely acknowledges that notable advances have been made in certain subjects, as for example in the studies on the physiology of the neural lobe.

An index sufficient to enable the reader to locate various subjects is appended. The full titles of the articles in the bibliography are given, which adds to the convenience and usefulness of the book. The opening sentence in the foreword, written by Professor A. J. Carlson, succinctly states what the author has accomplished: "Dr. van Dyke has again rendered a valuable service to biology and medicine in presenting in this second volume his critical digest of the experimental and clinical literature on the pituitary body that has appeared since 1935."

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SPECIAL ARTICLES

THE SENSITIZING PROPERTIES OF THE NUCLEIC ACIDS AND THEIR DERIVATIVES

THE chemical relationships between the nucleic acids and their physiological degradation products have been intensively studied; the part that these compounds may play in immunological phenomena, however, has never been investigated. Preliminary studies indicate that they may bear a fundamental relationship to pollen sensitization. The authors have found that individuals who gave positive skin reactions, when injected intradermally with ragweed pollen extract, likewise gave positive reactions when similarly tested with dilute solutions of nucleic acids and many of their derivatives. These reactions, so far demonstrated in a series of fifty ragweed pollen-sensitive human beings, appears to parallel the sensitivity of these individuals to ragweed pollen, regardless of the occurrence of symptoms of hay-fever. Only an occasional reaction has been observed in a group of forty non-allergic control cases, most of whom were normal individuals but some of whom were patients suffering from a variety of unrelated diseases. Likewise, five cases who gave positive reactions to animal danders, dust and foods, but not to ragweed pollen extract, also failed to react to the nucleic acid group of compounds.

The skin reactions elicited by the nucleic acids and their derivatives were the typical, immediate, wheal-erythema type. Such reactions were obtained uniformly upon the intradermal injection of 8_{γ} (.008 mg) of either thymus or yeast nucleic acid (neutralized before injection). Three crystalline nucleotides prepared from yeast nucleic acid, namely, adenine, guanine and cytosine nucleotides, gave positive reactions in doses of 2_{γ} (.002 mg). Likewise, crystalline adenine nucleotides prepared from beef heart muscle, beef pancreas and tea leaves reacted in the same manner. The simple purine salts, adenine sulfate, guanine chloride, hypoxanthine nitrate, xanthine nitrate and sodium urate all gave positive reactions in doses of 1_{γ} (.001 mg), as did also the simple pyrimidine uracil. Allantoin, the chief end product of purine metabolism in most mammals except man, likewise gave positive reactions. The simple compound urea has also given typical reactions.

The compounds mentioned above, with the exception of urea, are all concerned in the metabolism of the nucleic acids and all contain a purine or pyrimidine ring structure. The alkaloid caffein (which contains the purine ring) and the amino acid d.l. histidine mono-hydrochloride (which contains the imidazole ring) gave consistent reactions, but the amino acid l. proline (which contains the pyrrolidine ring) reacted less frequently.

A skin-sensitizing antibody to yeast nucleic acid, muscle and yeast adenine nucleotides, caffein, allantoin, histidine and urea has been demonstrated so far in the serum of ten individuals reacting to these compounds.

Severe constitutional reactions were produced in two patients, when only 0.02 mg of two adenine nucleotides prepared from yeast nucleic acid and from beef muscle, respectively, were used. For this reason only the small doses described above were employed in skin testing sensitive individuals.

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A POSSIBLE RELATION BETWEEN MANGANESE, SUNLIGHT AND WINTER HATCHABILITY OF HEN'S EGGS

IT has been observed at this station (unpublished data) that slipped tendon occurs more frequently in the heavy breeds of chickens that are raised in batteries in contrast to those that are raised out-of-doors on wire screens. Since the discovery of the relation of manganese to slipped tendon, little attention has been given to the effect of sunlight on this condition. Evidence that the manganese requirements of laying hens may be increased in the absence of sunlight is indicated by hatchability records obtained during the past two years.

It was found that a mash consisting of 45 parts of yellow corn, 15 of wheat bran, 15 of middlings, 5 of alfalfa leaf meal, 1.5 of granite grits, 1.5 of limestone grits, 1 of cod liver oil and 16 parts of soy-bean oil meal was improved for egg hatchability by the addition of 85 parts per million of manganese. This ration contained adequate amounts of vitamin D; however, during the fall and winter months (September to April) the average per cent. of hatchability of the fertile eggs laid by the hens fed this ration without added manganese was 48.1. The corresponding groups which received added manganese produced eggs having an average hatchability of 62 per cent. When there was adequate sunlight during the late spring and early summer, there was little significant difference in the egg hatchability between these two groups. The increase in hatchability of the eggs from the groups on the basal ration appears to be correlated with increased sunlight. Hatchability of these eggs increased to an average of 70 per cent. as compared to 75 per cent. hatchability of the eggs from the manganese-fed group. The effect of sunlight on the hatchability of the eggs from the basal group is shown very clearly in Fig. 1.

The bi-monthly hatchability of eggs laid by the first group (low manganese) was compared with the corresponding variations in temperature and hours of

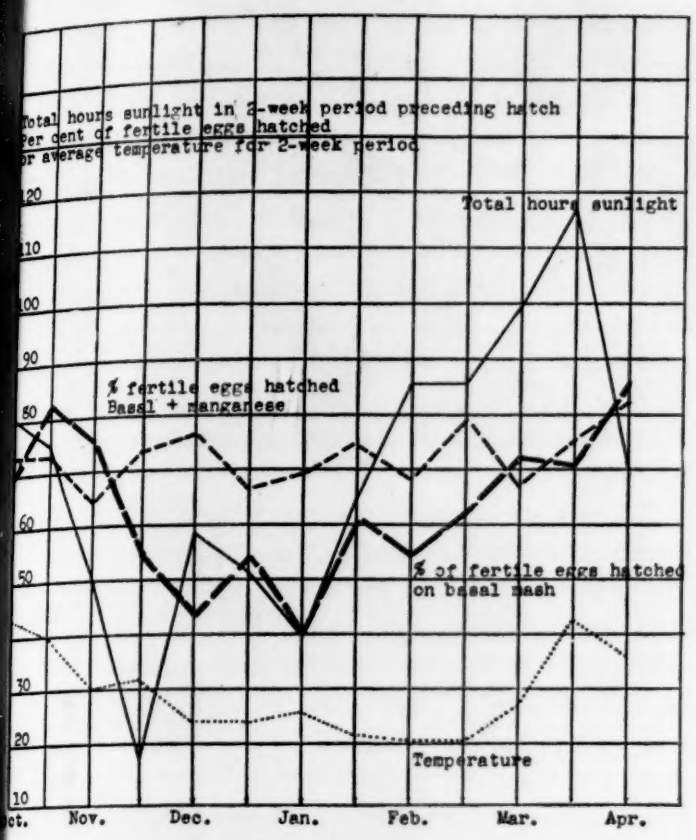

FIG. 1. The effect of manganese, sunlight, and temperature on hatchability of hen's eggs.

sunlight. The correlation was found between the total hours of sunlight during the 2-weeks period preceding the time the eggs were laid and the hatchability of the eggs. The period of diminishing per cent. of hatchability followed shortly after the period during which the total hours of sunlight diminished. Likewise the improvement in hatchability followed the increase in sunlight. There was no correlation between the fall or rise in the mean temperature and the per cent. of hatchability. Byerly, Titus, Ellis and Nestler[1] also have reported that hatchability of eggs from hens on a high soy-bean oil meal ration was markedly improved when the hens had direct access to sunlight. Since there was no fall in the hatchability of eggs from groups receiving added manganese, there must have been a borderline deficiency in the manganese content of the ration. During the spring, when there was adequate sunlight, this deficiency was eliminated, as was shown by the nearly equal hatchability of the two groups. That the vitamin D of cod liver oil was not a factor in the effect of sunlight has been shown by a number of experiments.

What explanation can be given for this apparent sparing action of sunlight on a hen's requirement for manganese can not be stated at present.

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[1] T. C. Byerly, H. W. Titus, N. R. Ellis and R. B. Nestler, *Jour. Poultry Sci.*, 16: 323, 1937.

THE ELECTROPHORETIC ANALYSIS OF ANTIPNEUMOCOCCUS HORSE SERA

RECENT work has indicated that the antibody activity of antipneumococcus horse serum is associated with proteins which differ from the principal globulins of normal horse serum in both molecular weight[1] and electrical mobility.[2] These antibodies are heavier than the principal globulins and electrophoretic observations have indicated that they move with a velocity intermediate between those of the β and γ components of normal sera.[2]

We have made electrophoretic[3] measurements upon a number of antipneumococcus horse sera and of antibody concentrates from them. Our results differ from the foregoing in showing that the antibody activity in all our preparations has the same electrical mobility as the ordinary γ-globulin. This is illustrated in Fig. 1, which reproduces the Longsworth[4] mobility-concentration patterns of an antipneumococcus horse serum before and after absorption of the serum with specific polysaccharides. This photograph was made with a bivalent Types I and II antiserum; similar results have been obtained with a bivalent serum against Types IV and VIII pneumococci. The measured mo-

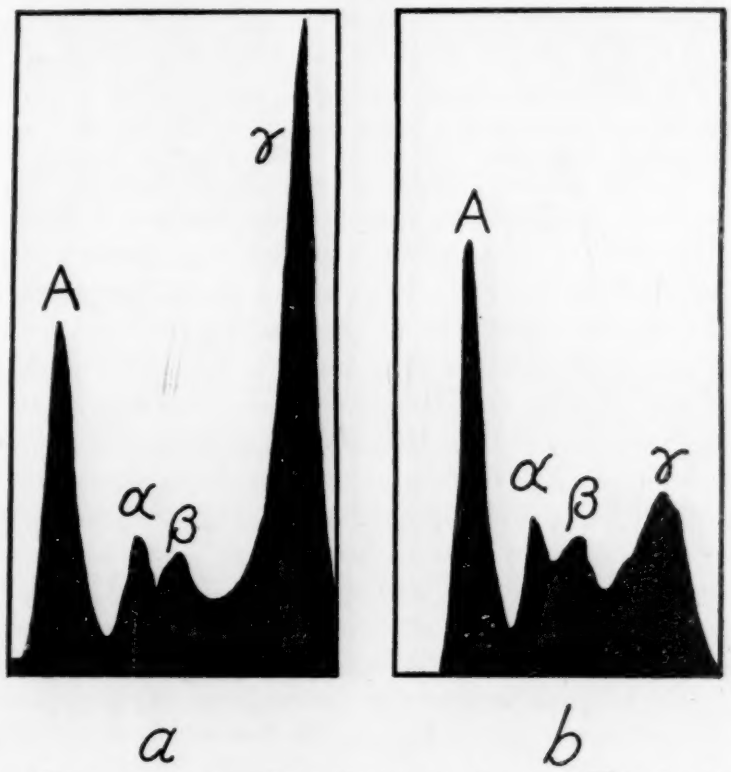

FIG. 1. Longsworth patterns of (a) unabsorbed and (b) absorbed antipneumococcus horse serum No. 6639. The albumin peak is designated by A, the globulin peaks by α, β, γ. The decrease in area of the γ-peak on absorption is evident.

[1] J. Biscoe, F. Hercik and R. W. G. Wyckoff, SCIENCE, 83: 602, 1936; M. Heidelberger and K. O. Pedersen, *Jour. Exp. Med.*, 65: 393, 1937.

[2] A. Tiselius and E. A. Kabat, SCIENCE, 87: 416, 1938; *Jour. Exp. Med.*, 69: 119, 1939.

[3] A. Tiselius, *Trans. Faraday Soc.*, 33: 524, 1937.

[4] L. G. Longsworth, *Jour. Am. Chem. Soc.*, 61: 529, 1939.

bilities of the various components in these sera are listed in Table 1; except for the absence in our photographs of the extra component with -2.1×10^{-5} cm^2 sec^{-1} volts^{-1} which had been identified as antibody, our measurements agree well with earlier ones.[2]

We have measured the areas under the globulin portion of the Longsworth photographs of sera before and after absorption with specific polysaccharides. This loss of area, limited to the γ-component, has paralleled the antibody content as determined by direct chemical[5] analysis (the last column of Table 1).

TABLE 1

Serum	Type	Mobility					Decrease in globulin area on absorption	Antibody per cent. of total globulin
		A	α	β	Antibody	γ		
		$-\mu \times 10^5$ cm^2 sec^{-1} volt^{-1}						
							%	%
6639	I and II	5.3	4.0	3.0	—	1.0	37	32
8617	IV and VIII	5.1	3.7	3.0	—	0.8	32	33
Tiselius and Kabat	.....	5.5	3.7	3.0	2.1	0.9		

We are not yet able to explain in satisfactory fashion the differences between our results and those of Tiselius and Kabat. Both sets of experiments were made at the same pH (7.7) and with similar buffers (0.15M NaCl, 0.02M total phosphates). All our accurate electrophoretic measurements have been made on sera diluted 1:4, but a few photographs of undiluted sera and of sera diluted 1:2 have given the same results. Though there is as yet only fragmentary evidence[6] to support the hypothesis, it is possible that the antibodies in a horse become smaller under prolonged immunization. The sera available for the present experiments were all from horses which had been producing antibodies for many years, and their antibodies may be different from those in the sera examined by Tiselius and Kabat.

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THE PHYSIOLOGICAL CHANGES PRODUCED IN YEAST BY ULTRA-VIOLET LIGHT AND BY HEAT

As part of an extensive investigation in these laboratories[1] of the effects of salts and lethal agents on biological systems an occasion has recently been found to make a comparative study of the effects of ultra-violet light and of heat. A single cell isolation of a strain of *Saccharomyces cerevisiae* was used as the test organism. Of the physiological functions studied, the ability of the cells to divide, thus forming colonies on agar, was found to be the most sensitive to both agents. The aerobic respiration of the cells was quite sensitive to heat, but proved to be relatively unaffected by ultra-violet light, that is, λ2650. Likewise, the resistance to staining with methylene blue is decreased by heat, but within comparable time limits is relatively unaffected by λ2650.

One of the more striking observations is that irradiation with λ2650 followed by heat treatment is two to five times as lethal as the treatment of the organisms in the reverse order. This is manifest in both the ability of the cells to form colonies and the resistance of the cells to staining.[2] Both functions are thus sensitized to heat by this wave-length. On the other hand, the rate of respiration is not sensitized, but is reduced by the same amount whether radiation is followed by heat treatment or *vice versa*.

The details of these experiments and the significance of the results in a general understanding of the nature of the lethal action of heat and ultra-violet light will be published shortly. In addition, the results give certain indications as to the mechanisms of the physiological processes studied and establish that certain of them are relatively independent of each other, *e.g.*, the ability of the cells to form colonies and their rate of respiration.

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[5] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 61: 559, 1935.

[6] See for instance, E. A. Kabat, *Jour. Exp. Med.*, 69: 103, 1939.

[1] B. M. Duggar and A. Hollaender, *Jour. Bacteriol.*, 37: 219–239, 241–256, 1934; A. Hollaender and B. M. Duggar, *Proc. Nat. Acad. Sci.*, 22: 19–24, 1936; A. Hollaender and W. D. Claus, *Jour. Gen. Physiol.*, 19: 753–765, 1936; A. Hollaender and B. M. Duggar, *Jour. Bacteriol.*, 36: 17-37, 1938.

[2] W. T. Bovie and G. A. Daland (*Amer. Jour. Physiol.*, 66: 55–66, 1923) have reported a similar sensitization of *Paramecium caudatum* to the lethal action of heat by irradiation with the short ultra-violet rays transmitted by fluorite ($\lambda < 2000$Å). The relation between our work and that of various investigators on the (small) temperature coefficient of the lethal action of ultra-violet light is probably rather remote.

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